Physics 311

Homework Set 13

1. A thick wire of radius R carries a *constant* current I, which is uniformly distributed over its cross section. A narrow gap in the wire of width w, where $w \ll R$, forms a parallel -plate capacitor, as shown in Fig. 7.45.
   Find the $\vec{B}$-field in the gap, at a distance $s < R$ from the axis.

2. Reconsider Problem 7 from Homework Set 12 of an alternating current $I(t) = I_0 \sin(\omega t)$ flowing down a long straight wire and returning along a coaxial conducting tube of radius b. The electric field was found to take the form

$$\vec{E}(s,t) = -\frac{\mu_0 I_0 \omega}{2\pi} \ln\left(\frac{b}{s}\right) \cos(\omega t)\hat{z}. \tag{1}$$

   a) Find the displacement current density $\vec{J}_d$.

   b) Integrate the displacement current to get the total displacement current

$$I_d = \int \vec{J}_d \cdot d\vec{a}. \tag{2}$$

   c) Compare I_d and I by calculating their ratio. If the outer cylinder had a radius of $b = 0.5$ cm, how high would the frequency have to be for I_d to be 1% of I?